

be appreciated that different lengths for different probes may be needed to achieve a particular  $T_{sub.m}$  where different probes have different GC contents). Although melting temperature is a primary consideration in probe design, other factors are optionally used to further adjust probe construction, such as selecting against primer self-complementarity and the like.

**WEST****End of Result Set**

Generate Collection

L9: Entry 1 of 1

File: USPT

Jan 5, 1993

DOCUMENT-IDENTIFIER: US 5177567 A

TITLE: Thin-film structure for chalcogenide electrical switching devices and process therefor

## GOPR:

This invention was made with Government support under Contract No. DNA-90-C-0048 awarded by the Defense Nuclear Agency.

## BSPR:

In light of the foregoing object, it is a first object of the present invention to provide a solid state thin-film switching device which includes a pair of spaced-apart electrodes between which is interposed and electrically connected, a body of chalcogenide switching material (a memory switch or a threshold switch depending on choice of chalcogenide material). The chalcogenide switching device of the present invention includes a substrate, a first electrode disposed on the substrate and a relatively thin layer of electrically insulating material disposed on the first electrode, the thin layer of insulating material defining an opening through which a first surface of the central portion of the body of chalcogenide material electrically communicates with the first electrode. The thin layer of insulating material is sufficiently thick to prevent the direct conduction of electrical current from the first electrode along the peripheral surface of the body of chalcogenide material to the second electrode, but not so thick as to cause step coverage problems during the deposition of the body of chalcogenide material. A second electrode is placed in electrical communication with the body of chalcogenide material at the surface of the chalcogenide material opposite that surface which is in direct communication with the first electrode. A relatively thick layer of electrically insulating material then covers at least the periphery of the body of chalcogenide material.

## BSPR:

Another object of the present invention is to provide a method for fabricating the aforescribed solid state thin-film chalcogenide switching device. The method includes the steps of providing a substrate, depositing a first electrode on the substrate, and depositing a relatively thin layer of electrically insulating material on the first electrode. The thin layer of insulating material is formed so as to define an opening communicating with the first electrode. After forming the opening, a body of chalcogenide material can be deposited on the thin insulating layer such that a first surface of a central portion of the body of chalcogenide material fills the opening and electrically communicates with the first electrode, the thickness of the layer of insulating material being sufficient to prevent direct electrical conduction from the first electrode along the periphery of the body of chalcogenide material to the edge of a second electrode, but not so thick as to cause step coverage problems during the deposition of the chalcogenide material. A second electrode is then deposited on the surface of the body of chalcogenide material opposite that of the first electrode, and finally, a relatively thick layer of electrically insulating material is formed on at least the peripheral surface of the body of chalcogenide material.

## DEPR:

communication with the layer of carbon 1b through the opening created in layer 6. An external contact 4 contacts and electrically communicates with the upper electrode 5a through the opening developed in the thick layer of insulating material 2. The external contact 4 may be patterned so as to provide a plurality of conductive address lines, thereby allowing access to a matrix of discrete electrical devices. The layer 1a, as well as the contact 4, may be electrically connected to other thin film devices operatively disposed on the same substrate or to terminal pads (not shown) for ease of connection to the switching device. The etching of the various thin film layers described herein may be accomplished using conventional etchants, either wet or dry, known to those ordinarily skilled in the semiconductor processing art.

DEPR:

A preferred process for producing the multi-layered structure of the switching device 11 of the instant invention is set forth hereinafter. Single crystal silicon is chosen for the substrate 7, said silicon being etched with a fluorine containing compound to cleanse the surface thereof. The multi-layers, molybdenum 1a and carbon 1b, which form the first electrode are then sequentially deposited upon the substrate by sputtering. The thin layer of insulating material 6, such as silicon nitride, is then deposited by Plasma Enhanced Chemical Vapor Deposition (PECVD). Photolithographic patterning is then employed so as to form a centrally located opening through the thin layer of insulating material. The photoresist is stripped therefrom and the substrate, with its deposited layers, is degassed at high temperature in a vacuum. The body of chalcogenide material 3 can then be deposited, by sputtering, such that the central portion of the body of chalcogenide material is placed in direct contact and electrically communicates with the layer of carbon 1b through the opening which has previously been formed in the thin layer of insulating material. Next, the upper layer of carbon 5b and the upper layer of molybdenum 5a, which combine to form the upper electrode, are sequentially deposited by sputtering and then photolithographically patterned. The layer of molybdenum is etched, the photoresist is stripped and the layer of carbon is etched, thereby forming the electrode. The body of chalcogenide material is photolithographically patterned and etched and the photoresist is stripped. Next, the thick layer of insulating material 2 is deposited by PECVD, patterned with photoresist, and an opening therethrough is etched. The remaining photoresist is stripped and the external contact is deposited thereon. As mentioned earlier, the external contact may be patterned with photoresist, etched and stripped to provide discrete electrically conductive address lines, thereby allowing access to the matrix of discrete electrical switching devices. Since techniques for depositing materials by sputtering, PECVD or evaporation and photolithographic patterning/etching are well known in the relevant art, further details of same need not be provided here.

DEPR:

In the preferred embodiment of the instant invention, it is desirable to provide an appreciable mass of thermally conductive material in intimate thermal contact with the upper and/or lower electrodes of the switching device for maximum dissipation of heat generated during device operation, especially when said devices are employed for high energy applications. This provides a thermal heat sink which helps avoid localized concentrations of elevated temperature which may, in the most aggravated instances, result in ablation of the body of chalcogenide switching material or layers of electrode materials adjacent to a local "hot spot." Those routineers skilled in the art will appreciate that a relatively thick, highly thermally conductive substrate, and a thick external electrical contact layer of heat sink material 4 (whether patterned or continuous) will greatly help in the dissipation of heat. For some applications, it may be sufficient to provide such heat dissipation material on only one side of the switching device, such as the substrate side. However, it is preferred, when possible, to provide such heat dissipation material on all electrode surfaces directly contacting or adjacent portions of the body of chalcogenide material 3.

DEPR:

When the substrate 7 is fabricated from an electrically conductive, high

Turning now to the drawings and, particularly, to FIGS. 1 through 3, there are depicted therein cross-sectional side views of three prior art chalcogenide switching devices 8, 9 and 10, respectively. In each of these figures, like elements have been assigned identical reference numerals. Each device includes a substrate 7 on which there is formed a dual layered electrode 1. Each device also includes a body of chalcogenide material 3 which acts as a switch (memory or threshold, depending upon the compositional and electrical characteristics of the particular chalcogenide material employed). a thick layer of electrically insulating material 2, and an uppermost electrical contact and heat sink 4. Device 9 (see FIG. 2) additionally includes an upper layer of electrode material 5 operatively disposed above the body of chalcogenide material 3. Each of the switching devices 8, 9 and 10 demonstrate, in actual use, one or more of the shortcomings in structural design which eventually are manifested as an electrical failure.

DEPR:

Referring now to FIG. 4, there is shown an electrical switching device 11 of the present invention which utilizes a pair of electrically switching conductive films of carbon material, 1b and 5b, respectively, as barrier layers between which is disposed the central body of chalcogenide material 3 and upper and lower metallic electrodes (as, for example, molybdenum) 1a and 5a. Each film of carbon material forms part of the electrode adjacent to which it is operatively disposed. The device 11 is formed on a substrate 7 which may be electrically conductive or insulating as required for the specific application in which the device will be employed. Stainless steel, copper, aluminum, and doped crystalline silicon are examples of suitable electrically conductive substrates; while glass, crystal silicon and crystal sapphire wafers are examples of suitable electrically insulating substrates. Successively deposited atop the substrate 7 are a layer 1a of electrode material, such as molybdenum, a thin film 1b of carbon, a thin layer of insulating material 6 which defines a centrally located opening, a body 3 of chalcogenide material, a thin film 5b of carbon, a top layer of electrode material, such as molybdenum, a thick layer of insulating material 2, and an external contact 4.

DEPR:

The thin films of carbon 1b and 5b are preferably deposited using DC magnetron sputtering. Typical process parameters are a substrate temperature of about 100.degree. C., a pressure of about 0.5 Pascal, a deposition rate of about 200-300 Angstroms per minute, and a distance of approximately 6 cm between the source and target. The resultant thin films of carbon are generally amorphous (a-carbon). Preferably, a carbon source is used so that the resultant films, deposited onto the substrate and the body of chalcogenide material, are substantially pure carbon. As used herein, pure carbon source means a source of material that is at least 99.9 percent carbon and preferably is 99.99 percent or more pure carbon. When amorphous carbon is sputtered under these conditions, it may exhibit an electrical resistivity as low as about 0.025 ohms-centimeters.

DEPR:

The layers of insulating material 2 and 6 may be fabricated of a variety of thin film dielectric materials, such as silicon oxide ( $\text{Si.sub.x O.sub.y}$ ), silicon oxynitride ( $\text{SiO.sub.x N.sub.y}$ ), silicon carbide, silicon oxycarbide, or, preferably, silicon nitride ( $\text{Si.sub.x N.sub.y}$ ). The thick layer of insulating material 2 may range in thickness from about 0.15 to 10.0 microns depending in part upon the thickness of the body of chalcogenide material 3 and the thickness of the thin layer of insulating material 6. The thin layer of insulating material 6 may range in thickness from about 0.01 to 1.0 microns depending again upon the thickness of the body of chalcogenide material 3. The preferred thicknesses of the layer 6 and layer 2, respectively, are about 0.1 microns and about 1 micron for a body of chalcogenide material having a thickness of about 1 micron. After layers 2 and 6 have been deposited, conventional photolithographic and etching techniques are used to develop openings (or vias or pores) in the electrically insulating material. When deposited, the body of chalcogenide material 3 is in indirect electrical

(FILE 'HOME' ENTERED AT 12:16:41 ON 11 DEC 2000)

FILE 'MEDLINE, BIOSIS, EMBASE, SCISEARCH, BIOTECHDS, IPA' ENTERED AT  
12:18:41 ON 11 DEC 2000

L1 13801 S SUBSTRATE AND IMMOBILI?  
L2 912 S SUBSTRATE AND CHIP  
L3 0 S L2 AND DIAMOD  
L4 15 S L2 AND DIAMOND  
L5 0 S L4 AND RADICAL  
L6 2 S L2 AND RADICAL  
L7 172 S L2 AND THERMAL  
L8 8 S L7 AND AMPLIF?  
L9 0 S L8 AND IMMOBILIZ  
L10 22488 S TAKAHASHI K/AU OR TANGA M/AU  
L11 20622 S L10 AND SUBSTRATE OR CHIP  
L12 185 S L11 AND DNA AND IMMOBILIZ?  
L13 477449 S L12 AND THERMAL OR HEAT  
L14 1135 S L11 AND (THERMAL OR HEAT)  
L15 9 S L12 AND THERMAL  
L16 477440 S L13 AND HEAT  
L17 3568 S L16 AND PCR  
L18 0 S L17 AND DIAMOND  
L19 0 S L18 AND AMPLIFI?  
L20 1116 S L17 AND (AMPLIFICATION OR AMPLIFY)  
L21 864 S L20 AND DNA  
L22 0 S L21 AND DIAMOND  
L23 0 S L21 AND RADICAL  
L24 135 S L21 AND (HYDROXYL OR CARBOXYL OR EPOXY OR AMINO)  
L25 0 S L24 AND (CYLANE OR TITANIUM OR ALUMINUM OR COUPLING AGENT)  
L26 0 S L24 AND (AMIDE OR ESTER) AND LINKAGE  
L27 83 DUP REM L24 (52 DUPLICATES REMOVED)  
L28 20167 S L27 AND SUBSTRATE OR CHIP  
L29 20 S L28 AND L10  
L30 20 DUP REM L29 (0 DUPLICATES REMOVED)

**WEST**

Generate Collection

L9: Entry 32 of 85

File: USPT

Oct 20, 1998

DOCUMENT-IDENTIFIER: US 5824517 A

TITLE: Method for amplifying nucleic acid sequences by strand displacement using DNA/RNA chimeric primers

## DEPR:

The pathways of entry described above can also be effected from a target captured by means of a probe attached to a solid substrate. This probe can be immobilized covalently or passively as described in French Patent No. 91 09057 and International Patent WO 91/19812. This probe immobilization can also be effected by means of (co)polymers, particularly an N-vinylpyrrolidone copolymer, to which probes are coupled in the form of a conjugate, said conjugate being immobilized on a solid substrate by passive adsorption. More particularly, primers A1 and/or A2, and C1 and/or C2, can be attached to a solid substrate provided this attachment is not effected by the 3' end of the primers, so that the 3' end of these primers is capable of extension by a DNA polymerase in the presence of deoxyribonucleoside triphosphates. In addition, all or part of the A1 and C1 primers on the one hand and A2 and C2 primers on the other hand can be connected to each other by any linking arm (a hydrocarbon, a nucleotide, or other), from their 5' end, in order to control and balance the respective quantities of A1 relative to C1 on the one hand and A2 relative to C2 on the other hand, in the amplification reaction described.

**WEST**

Generate Collection

L9: Entry 48 of 85

File: USPT

Jun 24, 1997

DOCUMENT-IDENTIFIER: US 5641658 A

TITLE: Method for performing amplification of nucleic acid with two primers bound to a single solid support

## DEPR:

An equimolar distribution of second and third nucleic acids, each complementary to a defined region of the plus and minus .DELTA. 508 gene sequences are immobilized via 5' ends on a derivatized substrate, e.g. microscope slide, microtitre plates, or glass beads. The fragmented genomic DNA, is allowed to hybridize with the first and second nucleic acid in the presence of thermostable polymerase, enzyme buffer, biotin labeled and unlabeled dNTP to form a reaction mixture. The reaction mixture is heated to 94.degree. C. for one minute, for denaturation, cooled to 55.degree. C. for one minute, for annealing, and warmed to 75.degree. C. for 1 minute, for amplification. After amplification the cycle of heating and cooling continues 30 times to form many first and second amplification products.

**WEST**

Generate Collection

L9: Entry 52 of 85

File: USPT

Jan 21, 1997

DOCUMENT-IDENTIFIER: US 5595870 A

TITLE: Identifying nucleic acids by restriction digestion and hybridization  
with random or pseudorandom oligonucleotides

## BSPR:

With the advent of recombinant DNA technology, the ability of nucleic acids to form hydrogen-bonded hybrids with complementary strands in solution or immobilized on solid-phase substrates has been widely exploited as a means for the characterization and analysis of gene structure and function. The isolation of a gene or mRNA as a recombinant molecule allows for the selective amplification and purification of that sequence. It is then possible to label that nucleotide sequence by a variety of techniques in order to specifically probe populations of nucleic acids for the presence of that particular sequence.



| <u>DB Name</u> | <u>Query</u>   | <u>Hit Count</u> | <u>Set Name</u>     |
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| USPT,DWPI      | 115 and (amplif\$ or PCR)                                      | 1                | <a href="#">L16</a> |
| USPT,DWPI      | 114 and substrate  | 8                | <a href="#">L15</a> |
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| USPT,DWPI      | 112 and chip   | 8                | <a href="#">L13</a> |
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| USPT,DWPI      | thermal conduct\$ and l4                                       | 0                | <a href="#">L5</a>  |
| USPT,DWPI      | 13 and (hydroxyl and carboxyl and epoxy and amino and radical) | 10               | <a href="#">L4</a>  |
| USPT,DWPI      | 12 and radical   | 64               | <a href="#">L3</a>  |
| USPT,DWPI      | 11 and diamond   | 275              | <a href="#">L2</a>  |
| DWPI,USPT      | substrate same immobiliz\$                                     | 6037             | <a href="#">L1</a>  |

**WEST****End of Result Set**

Generate Collection

L18: Entry 1 of 1

File: USPT

May 9, 2000

DOCUMENT-IDENTIFIER: US 6060327 A

TITLE: Molecular wire injection sensors

## DEPR:

Another example is of a sequence-specific DNA sensor. A specific sequence of single-strand DNA (nonconducting or insulating form) with 5' or 3' terminus thiol could be adsorbed to a gold electrode substrate. An analyte sample containing the complementary DNA sequence would produce a DNA double-strand polymer which is a conducting form of DNA. This result is a DNA sequence detector. DNA of the wrong sequence would not produce DNA double-strand polymer (conducting form). Appropriate end group functionalities on single-strand DNA or no end group modifications of single-stranded DNA (i.e., native DNA) using EMOLE methods could be used to put sequence-specific single-strand (insulating form) DNA on semiconductor substrates for use as a DNA sequence detector. DNA at crime scenes could be identified on the spot, doing away with PCR techniques and laborious and very costly DNA sequencing laboratory procedures.

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| PCR.DWPI,USPT.                        | 20039     |
| PCRS.DWPI,USPT.                       | 560       |
| ((("6060327".PN.) AND PCR).USPT,DWPI. | 1         |

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**WEST**

Generate Collection

L4: Entry 5 of 9

File: USPT

Aug 8, 2000

DOCUMENT-IDENTIFIER: US 6100030 A

TITLE: Use of selective DNA fragment amplification products for hybridization-based genetic fingerprinting, marker assisted selection, and high-throughput screening

## DEPR:

In the assays of the invention, either the polynucleotide probe or the amplified sample can be immobilized on a substrate prior to hybridization. Using different polynucleotide probes, one sample can be quickly and easily screened for the presence of many different polymorphisms generating a complex fingerprint based on the presence or absence of multiple polymorphisms. In addition, multiple samples can be screened for the presence of a particular marker. Thus, the present invention is a significant improvement over AFLP because it eliminates the need for gel electrophoresis of DNA fragments to produce a meaningful DNA fingerprint.

## DEPR:

In one embodiment, an array of probes are synthesized on a solid support. Exemplar solid supports include glass, plastics, polymers, metals, metalloids, ceramics, organics, etc. Using chip masking technologies and photoprotective chemistry it is possible to generate ordered arrays of nucleic acid probes. These arrays, which are known, e.g., as "DNA chips," or as very large scale immobilized polymer arrays ("VLSIPS.TM." arrays) can include millions of defined probe regions on a substrate having an area of about 1 cm.<sup>sup.2</sup> to several cm.<sup>sup.2</sup>, thereby incorporating sets of from a few to millions of probes.

## DEPR:

Light-directed combinatorial synthesis of oligonucleotide arrays on a glass surface is performed with automated phosphoramidite chemistry and chip masking techniques similar to photoresist technologies in the computer chip industry. Typically, a glass surface is derivatized with a silane reagent containing a functional group, e.g., a hydroxyl or amine group blocked by a photolabile protecting group. Photolysis through a photolithographic mask is used selectively to expose functional groups which are then ready to react with incoming 5'-photoprotected nucleoside phosphoramidites. The phosphoramidites react only with those sites which are illuminated (and thus exposed by removal of the photolabile blocking group). Thus, the phosphoramidites only add to those areas selectively exposed from the preceding step. These steps are repeated until the desired array of sequences have been synthesized on the solid surface. Combinatorial synthesis of different oligonucleotide analogues at different locations on the array is determined by the pattern of illumination during synthesis and the order of addition of coupling reagents. Monitoring of hybridization of target nucleic acids to the array is typically performed with fluorescence microscopes or laser scanning microscopes.

## DEPR:

It will be appreciated that probe design is influenced by the intended application. For example, where several allele-specific probe-target interactions are to be detected in a single assay, e.g., on a single DNA chip, it is desirable to have similar melting temperatures for all of the probes. Accordingly, the length of the probes are adjusted so that the melting temperatures for all of the probes on the array are closely similar (it will